THE STRUCTURE OF HAILSTONES.

By D. S. LANDIS, Assistant Observer. Dated Fort Worth, Tex., July 11, 1906.

On the evening of the 20th of June the observer at Fort Worth had an unprecedented opportunity to examine hailstones with reference to the formation of the centers. The hail fell for fifty minutes, and the stones were plentiful for several hours after the storm had passed. The hailstones of this storm were very symmetrical, the prevailing form being an oblate spheroid about two and a quarter inches in the long diameter by one and three quarter inches in the short axis. The largest stones had nine definitely marked concentric layers outside of the central nucleus. Three other styles of formation were in evidence, viz, those having three, five, and seven layers. These layers were distinguishable by being cemented, or congealed, together by sheaths of a thin white amorphous ice so devoid of thickness as not to be called a layer, yet in the cross sections the lines of separation were as well marked as those of the layers of an onion.

It was noted that every stone had an odd number of layers in its formation, the series running three, five, seven, or nine layers. The outside surfaces of all stones were quite smooth and of crystal ice. In the seven- and nine-layer hailstones the layer next to the surface layer was snowy, something of the nature of a snowball dipped into water and slightly compressed, forming a sort of mushy amorphous ice, usually very white. In the five-, seven-, and nine-layer formations, the third layer, counting from the nucleus outward, was an enwrapment of snow so definite in structure as to admit of no doubt of its being moist snow. This third layer was about as thick as heavy blotting paper. In the seven- and nine-layer formations the nucleus and all layers were crystal ice, excepting the third and the layer next to the surface layer.

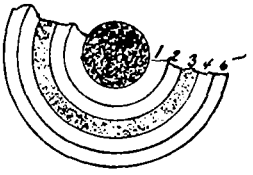

FIG. 1.

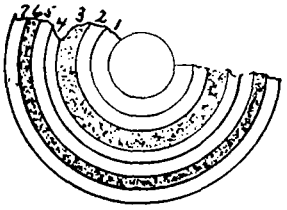

FIG. 2.

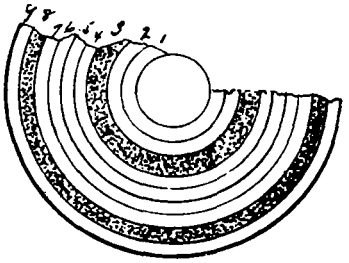

FIG. 3.

Figs. 1, 2, and 3 show the formations of hailstones having five, seven, and nine layers, respectively, outside the central nucleus. The stippled dark portions represent snow of a definite form, granular in a few instances, but not compact, as amorphous ice usually appears.

In the five-layer formations there were variations from the seven- and nine-layer stones, i.e., the five-layer formations always had a soft center or nucleus of either amorphous ice or snow. In two instances the centers presented such feathery frost needles that the contents could be shaken out by gently tapping the ruptured stone with a lead pencil, leaving a spherical cup of crystal ice, ragged and pitted within.

Another feature of this hailstorm, probably having some significance with reference to the altitudes at which these hailstones had been formed, was that at intervals of about ten seconds from the time a loud peal of near-by thunder was heard there would be a downpour of nine-layer hailstones, followed two seconds later by an increased shower of the seven-layer formations, and one second after these came the five-layer formations, immediately followed by the small three-layer pellets of ice.

During the storm the wind was blowing a gale, and the direction of descent of all stones was the same, except for the nine-layer formations. At intervals only, these came from a direction almost opposite to the course of the wind; the remainder of the time they came quartering with the wind. During the reverse action of the stones against the wind the descent was at an angle of about 60°, but at other times the descent was more nearly perpendicular.

The test for the presence of air within the stones showed that whenever a snowy or amorphous ice layer was reached air bubbles were in evidence. No air bubbles were given off from the three-layer stones, nor from the centers of the seven- and nine-layer formations. Whenever the five-layer centers were reached air bubbles were present, plainly showing the presence of enlocked air.

The snowy centers of the five-layer formations seem to have originated in a snow zone. The other nuclei must have been formed without the snow zone. The snowy layers, or amorphous ice conditions, noted in the seven- and nine-layer formations, indicate that the snow zone must have been passed twice.

In view of the observations made during this hailstorm it seems wrong to assert that the center of a hailstone is either crystal ice, or amorphous ice. It seems that the centers, or nuclei, are variable quantities, dependent upon the conditions of temperature and moisture, and the altitude at which the nucleus forms. With these factors in mind it is evident that the center of one stone might be crystal ice, another be amorphous ice, or mushy, like snow, while others can be dry snow, damp snow, or even frost itself.

By WELLINGTON SMITH. Dated Mifflintown, Pa., July 28, 1906.

We had a very severe hailstorm on Saturday, July 28, at 5 p. m. The stones were quite small at first, but at the end of twenty minutes they became large. They were flat and oblong, regularly corrugated from the center toward the circumference. They were from one inch to two inches in their longest diameter, and less, by one-third to one-fourth of these dimensions, in their shortest diameter. They were from one-half to three-fourths of an inch thick. They all were dished, or hollowed, toward the center, and some had holes. We gathered about a dozen stones from the board walk and placed them in ordinary pump water, but no one could see any bubbles ascend. Then we gathered some that fell on the heavy grass of the lawn, and these in a few minutes gave up very small bubbles. We then placed some more in a number of vessels of water, and bubbles were seen to ascend rapidly to the surface of the water. Most of these bubbles were exceedingly small, not larger than a grain of eagle powder, but I noticed quite a number as large as a common pin head. There was no mistake about the ascending bubbles of air, as every one in the house observed them.

The Fitchburg Sentinel of June 4 contains an account of a remarkable hailstorm occurring in the southern part of the town of Fitzwilliam, N. H., on Saturday afternoon, probably June 2. The storm cloud approached from the south about 4 p. m. Heavy rain, thunder, and lightning accompanied the hail. As the storm progressed the hailstones steadily increased in size, until at the end of ten minutes they were two inches in diameter. At 4:30 p. m. the storm was over, and observers began collecting the hailstones, which were generally either egg-shaped or round. Seventeen such stones filled a quart measure. The larger stones were buried their full depth in the earth. Most of the stones, if not all, had large, pure white, snowy nuclei, surrounded by a ring of transparent ice that was exceedingly hard.